CIRCULAR No. 234 AUGUST, 1932
UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

BLACK PIT OF THE PECAN AND SOME INSECTS CAUSING IT

By H. S. ADAIR,[1] *Assistant Entomologist, Division of Fruit and Shade-Tree Insects, Bureau of Entomology*

CONTENTS

INTRODUCTION

An important trouble which causes pecans to shed prematurely is known as black pit. No satisfactory explanation of this condition was given until 1927, when the writer (*1*)[2] discussed its relationship to mechanical and insect injury. This circular gives the results of investigations conducted by the Bureau of Entomology at Brownwood, Tex., during 1926, 1927, and 1928 to determine the cause of black pit and to devise means of control.

HISTORY AND ECONOMIC IMPORTANCE

Black pit was first considered a disease and was treated as such by McMurran and Demaree (*7*) in 1920. No organism was ever isolated, however, and the cause was attributed to environmental factors. One theory was that it might be a sort of natural dropping by which the number of nuts in a cluster was reduced. In 1927 the writer (*1*) discussed the relationship of mechanical and insect injury to this trouble, and gave insect punctures as one of the principal causes of black pit. Woodroof and Woodroof (*10*, *11*) in 1928 pointed out the relationship of mechanical and insect injury to the condition which they called black-heart, and which is essentially the same as black pit.

[1] The author expresses his appreciation of helpful suggestions received from G. F. Moznette, who is in charge of this bureau's laboratory for the study of pecan insects at Albany, Ga.

[2] Italic numbers in parentheses refer to Literature Cited, p. 13.

Black pit occurs throughout the pecan-producing sections of the South. Its importance in any locality depends largely on the abundance of the sucking insects causing the trouble.

It is difficult to evaluate the damage caused by black pit because the shedding of nuts during the summer may be due to other factors as well. The total midsummer drop also varies with the locality and with the season. Observations made in central Texas during 1926, 1927, and 1928, when there was a heavy midsummer drop, showed that 50 per cent or more of this drop was due to black pit. This premature shedding contributed greatly to reduction of yields, and the damage due to black pit was much greater than had previously been considered.

FIGURE 1.—An early stage of black pit. The internal tissues are brown and disorganized, but the surrounding husk is still green and shows no sign of injury

DESCRIPTION

McMurran and Demaree (*7, p. 19*) described black pit of the pecan as follows:

> The first observable stage of black pit consists of an internal browning of the nut and a disorganization of the internal tissues with no external evidence of the trouble, as shown in Figure 18. [Fig. 1.] The dead, brown internal tissues are surrounded in the beginning by a husk that is green and normal in every respect. No evidence of infection or injury of any sort is to be found on the nut in the early stages of the disease. However, as the disease progresses, the nuts take on the appearance shown in Figure 19. [Fig. 2.] Sunken glossy black spots and blotches appear, and shortly thereafter the nuts fall to the ground.

It should be added that the nuts affected are sometimes stained on the surface as a result of insect punctures. The punctures made by stinkbugs and plant bugs, however, are difficult to locate, and after the nuts have been on the ground a few days these punctures can seldom be found even with the aid of a magnifying glass.

FIGURE 2.—A later stage of black pit. The nuts fall from the tree soon after the sunken black spots and blotches appear on the husks

The drop of pecans, which usually occurs during May, according to Woodroof, Woodroof, and Bailey (*11*), is due to lack of fertilization. This drop is not usually confused with that due to black pit, which occurs later in the season after the nut has reached the water stage.[3] These investigators also describe a drop occurring during the summer, which they call abortion and which they attribute to some physiological condition. This drop is

[3] The water stage is that stage of the nut's development when the interior is filled with a watery substance later converted into the meat or kernel. For seedlings and most named varieties this stage lasts from the middle of June to the last of August.

more likely to be confused with the drop due to black pit. According to the same investigators, fresh drops due to abortion have no interior discoloration. The present writer has observed that aborted nuts may become slightly darkened inside after they have been separated from the twig for several days, but this discoloration is seldom so prominent as that in drops affected with black pit. Another difference is that the shuck of aborted nuts can be easily removed, whereas the shuck clings tightly to nuts affected with black pit.

DISCOVERY OF INSECT PUNCTURES IN NUTS AFFECTED WITH BLACK PIT

During the summer of 1926 several cases of severe shedding of nuts were reported by pecan growers in central Texas. Investigation showed that practically all the nuts that had dropped were affected with black pit.[4] The resemblance of black pit to kernel spot, which Turner (*9*) and Demaree (*4*) found to be due to insect punctures, suggested that the two diseases might have similar causes. Kernel spot is the result of punctures made in the nut after the kernel has formed. It produces brown spots on the kernel but does not cause the nut to drop, whereas black pit causes the entire inside of the nut to deteriorate, with the result that it drops prematurely. Nuts affected by black pit showed no sign of insect injury on the surface, even when examined with the aid of a binocular microscope. However, by cutting away the surface of the shuck of affected nuts with a safety-razor blade, it was possible to locate tiny punctures made by sucking insects, and these punctures could be traced to the interior of the nut. The first examinations were made about the middle of July, when the nuts were growing rapidly, and therefore the small holes made in the surface were nearly closed, whereas punctures made later in the season, when surface growth was not so great, were much easier to locate. Frequently nuts affected with black pit late in the season were stained on the surface by juice from the nut as a result of being punctured. The finding of unmistakable punctures caused by insects indicated that the punctures had some relation to the black-pit condition.

EXPERIMENTS TO INDUCE BLACK PIT

PIN PUNCTURES

In 1926 experiments were conducted to determine the effect of puncturing immature pecans with a small pin. On July 28 six pecans, still on the tree, were punctured with a No. 00 insect pin. A single puncture was made in the side of each nut. On July 30 two of the nuts were removed and examined. They came off more easily than nuts that had not been punctured. Both nuts showed a brownish discoloration, which appeared to be spreading from the place where the pin had entered the pit or watery portion of the nut. On August 2 the four other punctured nuts dropped. Upon examination they were found to be black within and to possess every characteristic of black pit.

On August 5 the test was repeated using four clusters of two nuts each and one cluster of three nuts. One nut in each of the four

[4] The trouble was identified as black pit by J. B. Demaree, pathologist, U. S. Bureau of Plant Industry, Thomasville, Ga.

clusters containing two nuts each and all the nuts in the cluster containing three nuts were punctured with a No. 00 insect pin. On August 8 five of the punctured nuts were removed and examined. Four nuts showed the black-pit discoloration and one remained normal, but in the latter case the puncture had not extended into the watery portion of the nut. On August 17 the six other nuts in the five clusters were removed. Of the two nuts that had been punctured, one was affected with black pit and one remained normal, but the puncture in the normal nut had not reached the watery portion. The four nuts in these clusters used as checks remained normal.

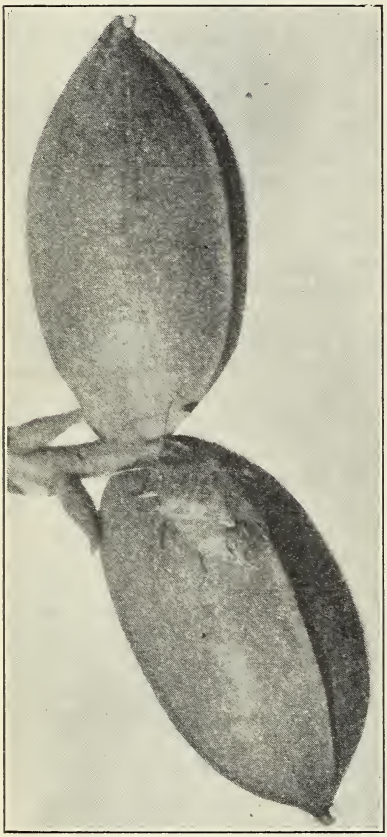

FIGURE 3.—*Euschistus euschistoides:* Adult on pecan. (Natural size)

PLACING INSECTS ON IMMATURE PECANS

Other tests were conducted to determine the relationship of certain sucking insects to black pit. Three species commonly found on pecan trees, *Euschistus euschistoides* Voll. (fig. 3), *Leptoglossus oppositus* Say (fig. 4), and *L. phyllopus* L. (fig. 5), were used. A number of cylindrical screen-wire cages (fig. 6) were constructed, some 12 to 14 inches in diameter and 18 inches long, and others 4 inches in diameter and 6 inches long. From 10 to 15 insects were placed in the large cages, and the cages were placed over a limb containing several clusters of nuts; in the small cages two to three insects were used, and the cages were placed over a single cluster of nuts. Check cages containing no insects were placed on the same limbs with the cages containing the insects. The results of these experiments are given in Table 1.

TABLE 1.—*Experiments to determine the result of feeding on immature pecans by sucking insects, Brownwood, Tex., 1926*

Kind of insect	Pecans	Period exposed to insect feeding	Pecans with black pit	Remarks
	Number	*Days*	*Number*	
Euschistus euschistoides	7	9	7	
Do	14	10	10	4 nuts with fresh punctures.
Check	11		0	
Leptoglossus phyllopus	6	7	0	None punctured.
E. euschistoides	12	21	7	4 nuts with kernel spot, one nut with fresh puncture.
Check	10		0	

TABLE 1.—*Experiments to determine the result of feeding on immature pecans by sucking insects, Brownwood, Tex., 1926*—Continued

Kind of insect	Pecans	Period exposed to insect feeding	Pecans with black pit	Remarks
	Number	*Days*	*Number*	
L. phyllopus	8	6	5	1 nut not punctured, 1 nut with fresh puncture, 1 nut with kernel spot.
L. phyllopus	17	5	15	2 nuts not punctured.
L. oppositus				
E. euschistoides	13	4	13	
Check	14		0	
L. phyllopus	9	7	9	
L. oppositus				
Check	5		0	
L. phyllopus	13	4	9	4 nuts undetermined.
L. oppositus				
Check	5		0	
E. euschistoides	10	10	10	
Do	3	12	3	
Do	4	12	4	
Do	5	12	5	
Do	3	12	3	
Do	3	12	3	
Check	4		0	
L. phyllopus	5	7	5	
L. oppositus				
L. phyllopus	10	7	10	
L. oppositus				
Check	7		0	
L. phyllopus	10	17	10	
L. oppositus				
E. euschistoides	3	10	3	
Do	2	10	2	
Do	2	10	2	
Do	4	10	4	
Do	4	10	4	
Check	4		0	
L. phyllopus	14	9	14	
L. oppositus				
Check	4		0	
E. euschistoides	14	15	12	2 nuts not punctured.
Do	8	9	8	
Check	3		0	

During 1927 and 1928 other tests, similar to those described above but using only the species *Leptoglossus phyllopus*, were conducted. The results of these experiments are given in Table 2.

TABLE 2.—*Experiments to determine the result of feeding on immature pecans by Leptoglossus phyllopus, Brownwood, Tex., 1927 and 1928*

Pecans (number)	Period exposed to insect feeding	Pecans with black pit	Pecans (number)	Period exposed to insect feeding	Pecans with black pit
	Days	*Number*		*Days*	*Number*
4	16	[1] 3	2	12	2
3	([2])	0	4	([2])	0
5	16	5	6	4	6
3	([2])	0	4	4	4
3	12	3	4	7	4
4	12	4	4	7	4
4	12	4	4	20	4
5	12	5	3	20	3

[1] 1 nut undetermined. [2] Check.

The results given in Tables 1 and 2 may be summarized as follows: Thirty-nine cages containing sucking insects were placed over a total

of 255 pecans. Thirteen check cages, in which no insects were placed, inclosed 77 pecans. Of 255 nuts confined on the tree in cages with sucking insects, 228 developed black pit. The 27 nuts that did not become affected with black pit showed 11 not punctured, 6 containing fresh punctures which would have resulted in black pit, and 5 with kernel spot resulting from punctures made after the meat of the kernel had formed. The condition of the other 5 was undetermined. The 77 nuts in the check cages remained normal.

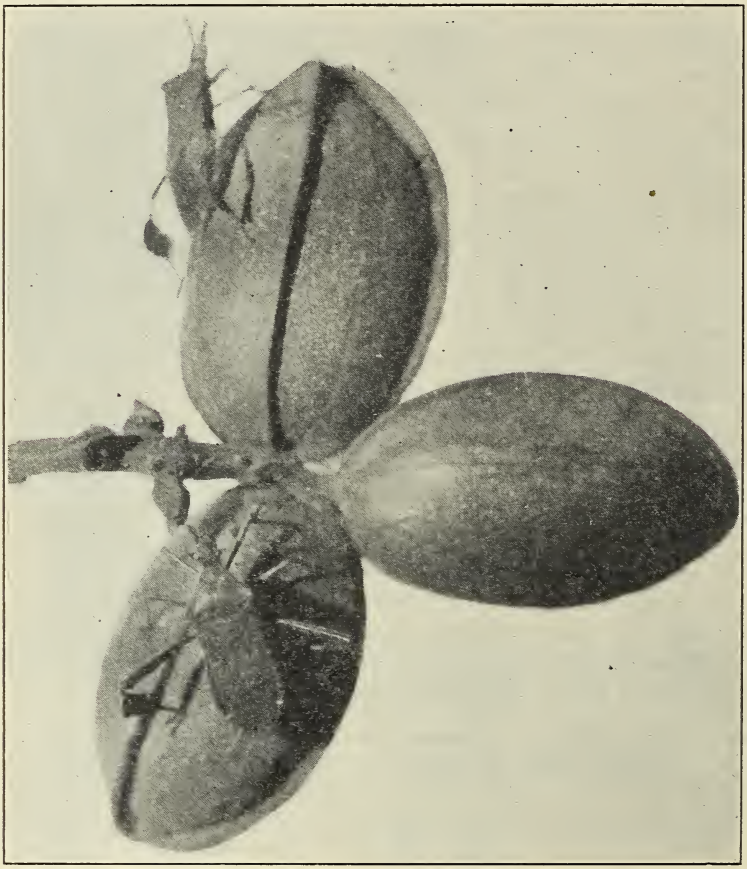

FIGURE 4.—*Leptoglossus oppositus:* Adults on pecans. (Natural size)

CONCLUSION AS TO CAUSE OF BLACK PIT

It was observed that punctures made by the pin and those made by insects were similar in size; moreover, when the pin was removed the pressure inside the nut forced some of the juice out through the hole in the same way as the juice was sucked out by the insects. The discoloration produced was the same. These results show that both mechanical and insect punctures made in the nuts while they are in the water stage will cause black pit. The pathological effects of the punctures were not studied. However, since black pit was

readily produced by punctures made by either a pin or an insect, it is ascribed to the result of mechanical rupturing of the host cells coupled with the extraction of juices from the affected tissues. This conclusion, which was recorded by the author in a previous publication (*1*), was corroborated by results recorded by Woodroof and Woodroof (*10*) in discussing black-heart. They found this condition to be invariably associated with insect or mechanical injury, and stated:

> We have produced typical black-heart nuts by puncturing them with a small dissecting needle, either sterile or unsterile. The region of broken cells turned black within one hour; on the second day vascular bundles leading from the injured area were darkened; and two days later the entire vascular system between the hull and shell was darkened. The packing tissue and seed coat on the interior of the nut turned dark by the fourth or fifth day and the nuts began dropping immediately. Dropping was 100 per cent ten days after the punctures were made.

FIGURE 5.—*Leptoglossus phyllopus:* Adult (× 1½)

Only the association of insects was sought in the experiments reported here and no attempt was made to determine other possible causes of shedding.

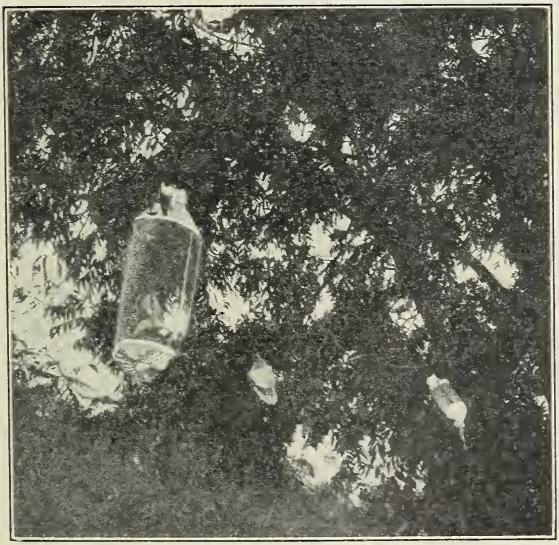

FIGURE 6.—Large and small screen-wire cages in place over clusters of pecans on tree

INSECTS WHICH CAUSE BLACK PIT

Since investigations show that black pit is produced by injuries to the internal tissues of the nut while it is in the water stage, it appears obvious that any insect that inflicts such injury by burrowing into or puncturing the nut will cause the trouble. The stinkbugs *Euschistus euschistoides* Voll. and *Nezara viridula* L, and the plant bugs *Leptoglossus phyllopus* L. and *L. oppositus* Say are known to puncture the pecans in feeding and cause the true black-pit condition; that is, interior discoloration and shedding of immature nuts, with little or no external evidence of injury. The adults of the pecan weevil (*Curculio caryae*

Horn) which appear in the orchard during midsummer puncture the pecans in feeding and cause black pit. The punctures made by the weevil, however, are larger than those made by the stinkbugs and plant bugs and are easily located. The characteristic interior discoloration and subsequent dropping of immature nuts have also been observed where injury has been caused by larvae of the pecan nut case-bearer (*Acrobasis caryae* Grote), hickory shuckworm (*Laspeyresia caryana* Fitch), and pecan curculio, (*Conotrachelus juglandis* Lec.). The injury of these insects, however, is evident on the surface of the nuts, is easily identified, and is usually classified as insect injury.

SEASONAL LIFE HISTORY OF STINKBUGS AND PLANT BUGS

After a definite relationship between insect punctures and black pit had been determined, investigations were conducted with the object of developing control measures for the insects causing the trouble. It was first necessary to learn the life history and habits of the species doing the damage. Accordingly studies of two species, *Euschistus euschistoides* Voll. and *Leptoglossus phyllopus* L., which were most commonly observed feeding on pecans in central Texas, were conducted during 1928. The breeding habits of these insects were given special attention, and an attempt was made to determine both native and cultivated host plants. Both species were found to have somewhat similar habits and with one exception, that of *L. phyllopus* breeding on peach, were found breeding on the same plants.

EUSCHISTUS EUSCHISTOIDES VOLL.

HIBERNATION

The nymphs of the last generation of the season transform to adults during late summer and early fall. They feed until late fall or early winter, when they seek places in which to hibernate. They have been found hibernating in bunches of grass and beneath leaves, pieces of bark, and similar objects that afford protection. They may leave their hibernating places and fly about during periods of warm weather in the winter. In the spring they leave their hibernating places as soon as the weather is moderately warm, usually in the latter part of March and in April.

OVIPOSITION

The eggs are deposited in clusters. (Fig. 7.) Individual eggs are held together, and to the surface on which the cluster is placed, by an adhesive substance given off by the female at the time of oviposition. In the field egg clusters have been found on the underside of leaves, and on the flower buds, twigs, and bark of trees. The number of eggs in a cluster differs, the average number in 18 clusters deposited by females in confinement being 28, with a minimum of 6 and a maximum of 44. The average number of eggs found in five dissected females was 35, the minimum being 19 and the maximum 49. Complete oviposition records were obtained for two females kept in confinement during midsummer. They were kept in battery jars and fed green peas and tomatoes. One female began laying 41 days after becoming an adult and deposited four clusters of eggs at intervals of 5, 4, and 3 days, the number in each cluster being 28, 33, 40, and 6,

respectively, a total of 107 eggs; the life of this female as an adult was 65 days. The other female began laying 34 days after becoming an adult and deposited four clusters of eggs at intervals of 1, 2, and 4 days, the number in each cluster being 32, 28, 28, and 24 eggs, respectively, a total of 112 eggs; the life of this female as an adult was 44 days.

LIFE CYCLE

The life cycle, from egg to adult, during midsummer, as determined from records obtained in 1928, requires from 31 to 39 days. The average incubation period from seven egg clusters, or 180 eggs, was 5.6 days, and the average nymphal period for 32 individuals was 29.9 days, or a total average life cycle of 35.5 days.

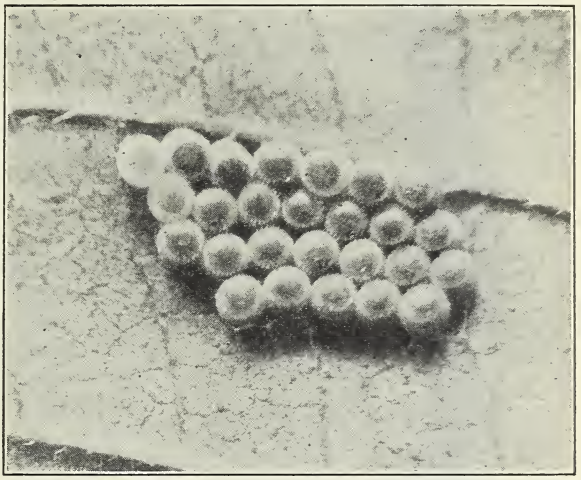

FIGURE 7.—Egg cluster of *Euchistus euschistoides* on underside of leaf (× 6)

HABITS OF NYMPHS AND ADULTS

The nymphs feed on the juices of succulent shoots, buds, or fruit of the preferred host plants. Upon hatching, the nymphs remain in a mass and do little or no feeding during the first instar. After the first molt they begin to feed but remain somewhat in groups through the nymphal period. Subsequent to the first molt, and especially during later instars, the nymphs are quite active when disturbed and seek protection by dropping to the ground or moving out of the disturber's range of vision. When handled, they give off a disagreeable odor which increases in strength with each succeeding instar.

The adults are strong fliers, but they do not migrate great distances except when food is scarce. During 1928 about 50 individuals were marked with a drop of red paint on the wings and liberated near the laboratory. Plenty of food was available at this point, and no marked individuals were ever observed very far from the place of liberation. When disturbed, the adults may drop to the ground and attempt to hide, or they may fly away. They are voracious feeders, and because of the long period in the adult stage they are capable of doing considerable damage by their feeding. They feed on the fruit of a number of plants, including the pecan. Although preferring the fruit, the adults often feed on the stems and shoots of succulent plants. Mating occurs a week or more before oviposition begins. Although a number of adults of the overwintering generation were under observation for several weeks before they went into hiberating quarters, no mating was observed.

NUMBER OF GENERATIONS

Only two generations occurred at Brownwood, Tex., during 1928. The first generation of nymphs became adults during June and July. The second generation was completed the latter part of August, during September, and the first part of October.

FIGURE 8.—Egg mass of *Leptoglossus phyllopus* on stem of plant. As evident in the photograph, the eggs hatched. (× 6)

HOST PLANTS

Although the adults feed on various plants, only a few have been found to serve as breeding plants. The native plants in central Texas found to be preferred hosts or breeding plants were purple-flowered thistle (*Cirsium virginianum*) and basketflower (*Centaurea americana*). The cultivated plants serving as preferred hosts were bean, cowpea, squash, and tomato. The adults are recorded by other writers as being general feeders on herbaceous plants, on birch, beech, and poplar trees, and on wheat. The author has observed them feeding on cockelbur, corn, cotton, mesquite, okra, peach, pecan, pepper, and soybean, in addition to the plants on which they are known to breed.

LEPTOGLOSSUS PHYLLOPUS L.

HIBERNATION

Leptoglossus phyllopus overwinters in the adult stage, hibernating in grass and under leaves and bark, as does *E. euschistoides*. Its habit of flying about during warm weather is similar to that of the species just discussed. Spring emergence dates are about the same for both species.

OVIPOSITION

The eggs of this species are deposited in single rows or chains along the stem or leaf petiole of a plant or the midrib of a leaf. (Fig. 8.) They are placed end to end and held together and to the surface of the plant by an adhesive substance given off by the female at the time of oviposition. Complete oviposition records were obtained for four females confined in battery jars and fed green peas and tomatoes.

The summarized records are as follows: Preoviposition days after becoming adult, 8 to 13, with an average of 10.7; oviposition days, 3 to 42, with an average of 27.5; number of egg masses laid by each female, 2 to 7, with an average of 5.2; eggs deposited at intervals of 1 to 15 days, with an average of 6.4; number of eggs in each mass, 5 to 58, with an average of 27.7; total number of eggs laid by each female, 51 to 217, with an average of 145.5; total life of females after becoming adults, 24 to 68 days, with an average of 48.

LIFE CYCLE

The life cycle during midsummer of 1928 was found to require from 39 to 87 days. The average incubation period for 19 egg masses, or 418 eggs, was 9.1 days, and the average nymphal period for 12 individuals was 44.7 days, or a total average life cycle of 53.8 days.

HABITS OF NYMPHS AND ADULTS

The habits of the nymphs and adults of this species were found to be similar to those of *E. euschistoides*.

NUMBER OF GENERATIONS

As with *E. euschistoides*, only two generations occurred at Brownwood during 1928. Although the average life cycle of this species was somewhat longer than that of *E. euschistoides*, the preoviposition period was shorter and the adults of corresponding generations of each species appeared in the field on about the same dates.

HOST PLANTS

Hubbard (*6, p. 169*) states that this species breeds on a large thistle. Chittenden (*3, p. 47*) says that the normal food plant of this bug is yellow thistle (*Cirsium spinosissimum*). Morrill (*8*) discusses this insect as a cotton pest and mentions the fact that nymphs appearing to be of this species were found on cotton bolls. Bissell (*2*) gives *Cirsium spinosissimum elliotti*, a red-flowered variety of yellow thistle; weakleaf (*Yucca flaccida*), purple Jimson weed (*Datura tatula*), and varieties of cowpeas as favored hosts of this species. In Texas the species was found breeding on the plants listed as preferred hosts of *E. euschistoides*—namely, purple-flowered thistle, basketflower, bean, cowpea, squash, tomato—and occasionally on peach.

In addition to the preferred hosts, the adults are recorded by various writers as feeding on a variety of other plants, including apricot, cantaloupe, *Cassia* sp., cherry, cocklebur, corn, currant, eggplant, gourd, grape, okra, orange, pear, pecan, pepper, potato, rose, *Rumex* sp., soybean, strawberry, and watermelon.

NATURAL CONTROL

WEATHER CONDITIONS

Weather conditions during the winter probably affect the numbers of these insects more than at any other period. Although no records were obtained which would indicate the mortality during the winter,

it is probably rather high. Dead bugs of both *E. euschistoides* and *L. phyllopus* have been collected on thistle plants in early spring following a sudden cold spell preceded by several days of warm weather. The fact that the insects often leave their hibernating places during warm periods doubtless tends to increase the mortality of overwintering insects, as they are more likely to be unprotected during a sudden cold spell following a warm period.

PARASITES

The egg stage of these insects seems to be most subject to the attack of parasites. The parasite *Telenomus dimmocki* Ashm., which is abundant during late summer, was reared from the eggs of *E. euschistoides*. An egg parasite, *Habronotus atriscapus* Gahan, was reared from the eggs of *L. phyllopus*. The adult *L. phyllopus* are attacked by a tachinid, probably *Trichopoda pennipes* Fab., which is known to parasitize adults of *L. oppositus*. Tachinid eggs were frequently observed on the head and thorax of adults, but only a single specimen was reared, and since it was not fully developed it could not be identified.

CONTROL MEASURES

In order to protect pecans from black pit caused by the puncture of sucking insects, it is necessary to adopt control measures against the species that feed on the pecan. Since the species *E. euschistoides*, *L. phyllopus*, *L. oppositus*, and *Nezara viridula* have similar breeding habits, the same measures of control will be applicable for all these species.

Hubbard (*6*, *p. 169*), in discussing the control of *L. phyllopus* in orange groves, says that the elimination of the preferred host plant, thistle, from the vicinity resulted in an almost complete disappearance of the insects from the groves. Gill (*5*), in recommending control measures for *Nezara viridula* as a protection against kernel spot in commercial pecan orchards, advises against the use of such legumes as cowpeas and soybeans as summer cover crops. He recommends the use of velvetbeans for this purpose, since the velvetbean is not a preferred host. The observations of the writer justify similar recommendations for control of the species of stinkbugs and plant bugs causing black pit. In early spring all native host plants that may be growing in or near pecan orchards, especially the preferred hosts such as the thistle, basketflower, yucca, and Jimson weed, should be destroyed. Such cultivated preferred host plants as the cowpea, bean, squash, and tomato, as well as any additional plants on which these insects are known to breed, should not be planted in or near orchards.

SUMMARY

Black pit is a condition affecting pecans and causing the shedding of immature nuts. This trouble occurs wherever pecans are grown and sometimes results in considerable loss to pecan growers. Affected nuts are black on the inside, with little or no evidence of the injury on the outside.

Investigations conducted to determine the cause of this trouble showed that black pit is produced by either mechanical or insect

punctures made in the nuts while they are in the water stage. Insect punctures made in the nuts after the meat of the kernel has formed produce kernel spot.

Although injury due to various pecan insects, such as the pecan nut case-bearer, hickory shuckworm, pecan curculio, and pecan weevil, causes discoloration and subsequent dropping of the nut, this injury is usually identified as insect injury and classified as such. The punctures made by species of stinkbugs and plant bugs feeding on pecans, however, are difficult to locate and the resulting injury is usually identified and classified as black pit. The species of stinkbugs and plant bugs known to feed on the pecans and cause black pit are *Euschistus euschistoides* Voll., *Nezara viridula* L., *Leptoglossus phyllopus* L., and *L. oppositus* Say.

The species *E. euschistoides* overwinters as an adult. The life cycle during midsummer requires approximately 35 days—5 days as egg and 30 days as a nymph. This insect was found breeding on thistle, basketflower, cowpea, bean, squash, and tomato. In addition to the preferred hosts or breeding plants, the adults feed on a variety of other plants. Two generations occurred at Brownwood, Tex., during 1928.

The species *L. phyllopus* also overwinters as an adult. The life cycle requires approximately 54 days—9 days as egg and 45 days as a nymph. This insect was found breeding on the same plants as *E. euschistoides*, and in addition was also observed breeding on peach trees. Other preferred hosts of this species recorded by other investigators are yucca and Jimson weed. In addition to the preferred hosts, the adults feed on a variety of other plants.

The control measure recommended as a means of preventing black pit due to the feeding of stinkbugs and plant bugs consists of the elimination from the vicinity of the pecan orchards of preferred host plants on which these insects breed.

LITERATURE CITED

(1) ADAIR, H. S.
1927. BLACK PIT OF PECAN. Amer. Nut Jour. 26: 6–7.

(2) BISSELL, T. L.
1929. NOTES ON LEPTOGLOSSUS PHYLLOPUS L. AND L. OPPOSITUS SAY. (Scientific Notes.) Jour. Econ. Ent. 22: 597–598.

(3) CHITTENDEN, F. H.
1899. SOME INSECTS INJURIOUS TO GARDEN AND ORCHARD CROPS. A SERIES OF ARTICLES DEALING WITH INSECTS OF THIS CLASS. U. S. Dept. Agr., Div. Ent. Bul. 19 (n. s.), 99 p., illus.

(4) DEMAREE, J. B.
1922. KERNEL-SPOT OF THE PECAN AND ITS CAUSE. U. S. Dept. Agr. Bul. 1102, 15 p., illus.

(5) GILL, J. B.
1924. IMPORTANT PECAN INSECTS AND THEIR CONTROL. U. S. Dept. Agr. Farmers' Bul. 1364, 49 p., illus.

(6) HUBBARD, H. G.
1885. INSECTS AFFECTING THE ORANGE. REPORT ON THE INSECTS AFFECTING THE CULTURE OF THE ORANGE AND OTHER PLANTS OF THE CITRUS FAMILY, WITH PRACTICAL SUGGESTIONS FOR THEIR CONTROL OR EXTERMINATION. U. S. Dept. Agr., Div. Ent., 227 p., illus.

(7) MCMURRAN, S. M., AND DEMAREE, J. B.
1920. DISEASES OF SOUTHERN PECANS. U. S. Dept. Agr. Farmers' Bul. 1129, 22 p., illus.

(8) MORRILL, A. W.
1910. PLANT-BUGS INJURIOUS TO COTTON BOLLS. U. S. Dept. Agr., Bur. Ent. Bul. 86, 110 p., illus.
(9) TURNER, W. F.
1918. NEZARA VIRIDULA AND KERNEL SPOT OF PECAN. Science (n. s.) 47: 490–491.
(10) WOODROOF, J. G., AND WOODROOF, N. C.
1928. THE DROPPING OF PECANS. Natl. Pecan Growers' Assoc. Bul. 2 (1): 28, 29–34, illus.
(11) ——— WOODROOF, N. C., AND BAILEY, J. E.
1928. UNFRUITFULNESS OF THE PECAN. Ga. Agr. Expt. Sta. Bul. 148, 40 p., illus.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE WHEN THIS PUBLICATION WAS LAST PRINTED

Secretary of Agriculture	ARTHUR M. HYDE.
Assistant Secretary	R. W. DUNLAP.
Director of Scientific Work	A. F. WOODS.
Director of Regulatory Work	WALTER G. CAMPBELL.
Director of Extension Work	C. W. WARBURTON.
Director of Personnel and Business Administration.	W. W. STOCKBERGER.
Director of Information	M. S. EISENHOWER.
Solicitor	E. L. MARSHALL.
Weather Bureau	CHARLES F. MARVIN, *Chief.*
Bureau of Animal Industry	JOHN R. MOHLER, *Chief.*
Bureau of Dairy Industry	O. E. REED, *Chief.*
Bureau of Plant Industry	WILLIAM A. TAYLOR, *Chief.*
Forest Service	R. Y. STUART, *Chief.*
Bureau of Chemistry and Soils	H. G. KNIGHT, *Chief.*
Bureau of Entomology	C. L. MARLATT, *Chief.*
Bureau of Biological Survey	PAUL G. REDINGTON, *Chief.*
Bureau of Public Roads	THOMAS H. MACDONALD, *Chief.*
Bureau of Agricultural Engineering	S. H. MCCRORY, *Chief.*
Bureau of Agricultural Economics	NILS A. OLSEN, *Chief.*
Bureau of Home Economics	LOUISE STANLEY, *Chief.*
Bureau of Plant Quarantine	LEE A. STRONG, *Chief.*
Grain Futures Administration	J. W. T. DUVEL, *Chief.*
Food and Drug Administration	WALTER G. CAMPBELL, *Director of Regulatory Work, in Charge.*
Office of Experiment Stations	JAMES T. JARDINE, *Chief.*
Office of Cooperative Extension Work	C. B. SMITH, *Chief.*
Library	CLARIBEL R. BARNETT, *Librarian.*

This circular is a contribution from

Bureau of Entomology	C. L. MARLATT, *Chief.*
Division of Fruit and Shade-Tree Insects	———, *in Charge.*

U. S. GOVERNMENT PRINTING OFFICE: 1932

For sale by the Superintendent of Documents, Washington, D. C. - - - - - Price 5 cents